

ANTI-THEFT DEVICE OF VEHICLE

BACKGROUND OF THE INVENTION

Field of the Invention

[0001]

The present invention relates to an anti-theft device of vehicle such as a 4-wheeled vehicle or a motorcycle.

Description of Background Art

[0002]

A conventional anti-theft device of vehicle is that the anti-theft operation of which can be set by turning off the ignition switch of vehicle. However, since there is a case in which the anti-theft device is not desired to be set for example during fuel charge at a gas stand, there has been developed an anti-theft device of which setting of anti-theft can be avoided if the key of ignition switch is positioned at a position other than OFF position when the ignition switch is turned off. In addition there has been developed an another type of anti-theft device of vehicle in which the anti-theft can be released if the key of ignition switch is operated to a position other than ON position when the ignition switch is turned on from a condition in which the anti-theft has been set (see Japanese Laid-open Patent Publication No. 211564/2000).

Disclosure of the Invention

Problems to be solved by the Invention

[0003]

However according to the anti-theft devices of vehicle of the prior art, it is necessary to turn the ignition switch key to a position other than OFF position in order to avoid the alarm means of the anti-theft device to be operated when the ignition switch is turned off for example during fuel charge at a gas stand. This complicates the operation of the anti-theft device.

In addition, due to its complicated operation, a user would often forget the operation of the anti-theft device and thus unexpected alarm sound would be generated because of unintended setting of the anti-theft device.

## SUMMARY OF THE INVENTION

【0004】

It is, therefore, an object of the present invention to provide an anti-theft device of vehicle which can easily determine whether or not the anti-theft device should be set on its caution condition, prevent generation of unintentional alarm sound as well as disability of start of engine, and also easily select setting or not of caution condition in accordance with user's preference.

### Means for solving the problems

【0005】

According to the present invention of claim 1, there is provided an anti-theft device of vehicle comprising at least one of an alarm means for generating alarm on detection of theft and an immobilizer means for preventing the start of engine on detection of theft characterized in that at least one of the alarm means and the immobilizer means can be set to a caution condition when an ignition switch of vehicle is turned off under a condition in which a dimmer switch is either in a high-beam or a low-beam position.

【0006】

According to an anti-theft device of vehicle of claim 2, a user can freely select at his will the setting or unsetting of the alarm means and the immobilizer in which position the dimmer switch is selected.

【0007】

According to the present invention of claim 3, there is provided an anti-theft device of vehicle comprising at least one of an alarm means for

generating alarm on detection of theft and an immobilizer means for preventing the start of engine on detection of theft characterized in that at least one of the alarm means and the immobilizer means can be set to a caution condition when an ignition switch of vehicle is turned off under a condition in which a headlight is either in lighting or lighting-off.

【0008】

According to an anti-theft device of vehicle of claim 4, user can freely select at his will the setting or unsetting of the alarm means and the immobilizer in which condition the headlight is there.

【0009】

According to the present invention of claim 5, there is provided an anti-theft device of vehicle comprising at least one of an alarm means for generating alarm on detection of theft and an immobilizer means for preventing the start of engine on detection of theft characterized in that at least one of the alarm means and the immobilizer means can be set to a caution condition in accordance with a combination of a high-beam or a low-beam position of a dimmer switch and a lighting or lighting-off condition of a headlight.

【0010】

According to an anti-theft device of vehicle of claim 6, a user can freely select at his will the setting or unsetting of the alarm means and the immobilizer in which combination of the dimmer switch position and the headlight condition is there.

【0011】

According to an anti-theft device of vehicle of claim 7, a setting confirmation sound is generated when the alarm means or the immobilizer means is set.

【0012】

According to an anti-theft device of vehicle of claim 8, the alarm means

comprises a hazard warning lamp flashing means for flashing hazard warning lamps during operation of the alarm means and a hazard warning lamp flashing switch and can start the flashing of the hazard warning lamps by the hazard warning lamp flashing switch under a condition in which the caution means is not set.

[0013]

According to an anti-theft device of vehicle of claim 9, the alarm means is a piezoelectric buzzer; wherein further comprising a control section having a oscillating means for controlling the anti-theft device of vehicle and for generating a signal for the piezoelectric buzzer, and a piezoelectric driving section for driving the piezoelectric buzzer; and the control section, piezoelectric buzzer driving section and the piezoelectric buzzer are formed as a unit.

#### Effects of the Invention

[0014]

According to the invention of claim 1, it is possible to easily determine whether or not the anti-theft device should be set on its caution condition simply by selecting either one of the high-beam position or the low-beam position of the dimmer switch, In addition, because of easiness of selection of high-beam position or the low-beam position of the dimmer switch, it is possible to prevent generation of unintentional alarm sound as well as disability of start of engine.

[0015]

According to the invention of claim 2, since it is possible to select at user's will whether the alarm means or the immobilizer means should be set on which position the dimmer switch is positioned, easy selection can be obtained in accordance with a user's preference.

[0016]

According to the invention of claim 3, it is possible to easily determine

whether or not the anti-theft device should be set on its caution condition simply by selecting the condition of the headlight either on its lighting condition or lighting-off condition. In addition, because of such an easiness of selection, it is possible to prevent generation of unintentional alarm sound as well as disability of start of an engine.

[0017]

According to the invention of claim 4, since it is possible to select at user's will whether the alarm means or the immobilizer means should be set in which condition the headlight is there, easy selection can be obtained in accordance with a user's preference.

[0018]

According to the invention of claim 5, it is possible to easily determine whether or not the anti-theft device should be set on its caution condition simply by selecting the combination of a high-beam or a low-beam position of a dimmer switch and a lighting or lighting-off condition of a headlight. In addition, because of such an easiness of selection, it is possible to prevent generation of unintentional alarm sound as well as disability of start of an engine.

[0019]

According to the invention of claim 6, since it is possible to select at user's will whether the alarm means or the immobilizer means should be set in which condition the dimmer switch and the headlight are there, easy selection can be obtained in accordance with a user's preference.

[0020]

According to the invention of claim 7, since the setting confirmation is generated when the alarm means or the immobilizer means is set, it is possible to easily know whether the anti-theft device is set on the caution condition or not.

[0021]

According to the invention of claim 8, since it is possible to start the flashing of the hazard warning lamps by the hazard warning lamp flashing switch on a condition in which the alarm means is not set, it is possible to easily add a hazard warning lamp flashing function to a vehicle not equipped with such a function.

[0022]

According to the invention of claim 9, since the control section, piezoelectric buzzer driving section and the piezoelectric buzzer are formed as a unit and the control section has the oscillating means for controlling the anti-theft device of vehicle and for generating a signal for the piezoelectric buzzer, it is possible to change an oscillating frequency at a side of the control section and thus to appropriately change the sound of the piezoelectric buzzer. In addition, it is possible to adjust the sound pressure level of the piezoelectric buzzer by utilizing a frequency characteristics between the frequency of the piezoelectric buzzer and the sound pressure level.

### BRIEF DESCRIPTION OF THE DRAWINGS

Additional advantages and features of the present invention will become apparent from the subsequent description and the appended claims, taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a block diagram showing an arrangement of a first embodiment of the anti-theft device of vehicle of the present invention;

Fig. 2 is a block diagram showing a detailed arrangement of a first embodiment of the anti-theft device of vehicle of the present invention;

Fig. 3 is a flow chart showing the operation of the first embodiment of the anti-theft device of vehicle of the present invention;

Fig. 4 is a flow chart showing the operation of a second embodiment of the anti-theft device of vehicle of the present invention;

Fig. 5 is a flow chart showing the operation of a third embodiment of the

anti-theft device of vehicle of the present invention;

Fig. 6 is a flow chart showing the operation of a fourth embodiment of the anti-theft device of vehicle of the present invention; and

Fig. 7 is a schematic view showing an another embodiment of the anti-theft device of vehicle of the present invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023]

The present invention will be hereinafter described with reference to accompanied drawings. The anti-theft device of vehicle is intended to prevent theft of vehicles such as 4-wheeled vehicles and motorcycles and has means for detecting the theft and inform it to persons around the vehicle or its user.

### First embodiment

[0024]

Fig. 1 is a block diagram showing an arrangement of a first embodiment of the anti-theft device of vehicle of the present invention; Fig. 2 is a block diagram showing a detailed arrangement of a first embodiment of the anti-theft device of vehicle of the present invention; and Fig. 3 is a flow chart showing the operation of the first embodiment of the anti-theft device of vehicle of the present invention.

[0025]

As shown in drawings, an anti-theft device of vehicle 1 comprises an anti-theft control circuit 5 and relays 6~8. Connected to the anti-theft device of vehicle 1 are an ignition switch 10, a dimmer switch 15, a headlight 16, a sensor 17, an ECU 11, a turn signal lamp (L) 25, a turn signal lamp (R) 26, an alarm means 20, and an indicator 21. The ignition switch 10 is a main switch of vehicle and an engine can be started by turning the ignition switch 10 "ON". The ECU 11 is an electronic control unit for controlling the engine. The ignition switch 10 can control "ON/OFF" of electric power supply to the ECU

11. The "ON/OFF" control between the ignition switch 10 and the ECU 11 is carried out by contact points of the relay 6. That is, when the relay 6 is not set "ON", any electric power cannot be supplied to the ECU 11 and thus the engine cannot be started and this condition forms the immobilizer means. The condition whether the ignition switch is "ON" or "OFF" has been previously inputted to the anti-theft control circuit 5.

[0026]

The turn signal lamp (L) 25 and the turn signal lamp (R) 26 are "OR" connected to a circuit (not shown) "ON/OFF" controlled by a turn signal switch and can be lit by the control from the anti-theft device 1. The relay 7 is set "ON" to light the turn signal lamp (L) 25 and the relay 8 is set "ON" to light the turn signal lamp (R) 26. The dimmer switch 15 is a switch for setting the high beam position or the low beam position of the headlight 16. The position of the dimmer switch 15 has been previously inputted to the anti-theft control circuit 5. The position "ON" or "OFF" of the headlight is also inputted to the anti-theft control circuit 5.

[0027]

The anti-theft control circuit 5 is formed by a microcomputer (CPU) and an input/output circuit and controls whole the anti-theft device of vehicle 1 using its dedicated program. However other means such as a sequencer or a logic circuit may be used for controlling the circuit 5. The alarm means 20 is a sound generator such as a buzzer. The indicator 21 is for example LEDs or lamps for indicating the operating condition of the anti-theft device 1. The sensor 17 is for example an acceleration sensor, a gravity sensor, etc. for detecting unintentional movement of vehicle by detecting inclination or vibration of vehicle. The indicator 21 is arranged at a place giving easy view for a driver of vehicle. Although the mounting position of the anti-theft device 1 is not limited, it is preferable to select a place difficult to remove the device 1 from outside of vehicle.



[0028]

Although the arrangement shown in Figs. 1 and 2 includes two immobilizer means for inputting the ignition switch 10 to relay 6, it is sufficient for the anti-theft device 1 to include at least one immobilizer means. In addition although the arrangement is structured so that respective conditions of the dimmer switch 15 and the headlight 16 can be inputted, it is sufficient for the anti-theft device 1 to have at least one of them. Furthermore, the function of lighting the turn signal lamps (L, R) 25 and 26 is not necessarily required.

[0029]

Then the operation of the anti-theft device of vehicle 1 will be hereinafter described. Reference numerals enclosed in brackets in the following description correspond to those shown in a flow chart of Fig. 3.

[0030]

In the description below, circumstances in which the anti-theft device 1 is set when the dimmer switch 15 is in the low beam position will be described (No. 1 in Table 1 below). Table 1 shows several combinations of setting obtained from positions of the dimmer switch 15. Details of Table 1 will be described later.

[0031]

(Table 1)

		Dimmer switch	
		Low position	High position
No.1	Alarm+Immobilizer	Set	—
No.2	Alarm+Immobilizer	—	Set
No.3	Alarm	Set	—
No.4	Alarm	—	Set
No.5	Immobilizer	Set	—
No.6	Immobilizer	—	Set

[0032]

First of all, the condition of the ignition switch 10 is observed (S101) and

concrete control is carried out when the ignition switch 10 is turned "OFF" (S101-OFF). When the ignition switch 10 is turned "OFF", confirmation of the position of the dimmer switch 15 is carried out (S102). When the dimmer switch 15 is in the high beam position, it is not shifted to the anti-theft caution condition and thus the operation of the ignition switch 10 causes only stop of engine (S102-Hi).

[0033]

When the dimmer switch 15 is in the low beam position (S102-low), the anti-theft is set (S103). One concrete content of the setting of anti-theft is, first of all, to generate setting confirmation sound for indicating the setting of anti-theft. The setting confirmation sound is generated by using the alarm means 20. In addition, the immobilizer means is operated so that the relay 6 is turned "OFF" not so as to start an engine. Then it is indicated by flashing the indicator 21 that the situation is now in the anti-theft caution condition (S104). Thus the driver can leave his (or her) vehicle.

[0034]

When the key is inserted to the ignition switch 10 and turned "ON" during the anti-theft caution condition (S105-ON), the anti-theft is released (S108). One concrete content of the releasing of anti-theft is to light-out the indicator 21 and to stop the immobilizer means by turning the relay 6 "ON".

[0035]

Under the anti-theft caution condition, operation of the sensor 17 is observed by the anti-theft control circuit 5 (S106). If the sensor 17 detects unintentional vibration or movement of vehicle under the anti-theft caution condition (S106-Yes), alarm is generated (S107). One concrete content of the alarm is to generate alarm sound by the alarm means 20. It is additionally possible to flash the turn signal lamps (L, R) 25 and 26.

[0036]

As described above, since it is shifted to the anti-theft caution condition

when the ignition switch 10 of vehicle is turned "OFF" under the low beam position condition of the dimmer switch 15, it can be easily determined whether or not it should be set in the anti-theft caution condition only by selecting the position (high beam or low beam position) of the dimmer switch 15. The easiness of selection makes the selecting method unforgettable and thus makes it possible to prevent generation of unintentional alarm sound and disability of start of engine. That is, when a driver does not want to set the anti-theft device 1, for example, when a driver leaves a vehicle within a range the eye can reach e.g. such as a case of fuel charge at a gas station, it can provide easy selection and prevent unintentional generation of alarm sound and disability of start of engine only by setting the ignition switch 15 at the high beam position.

【0037】

Although it has described above that the alarm means and the immobilizer means are set when the dimmer switch 15 is in the low beam position as shown in No.1 in Table 1, it is also possible to make the condition of the anti-theft device 1 so that the alarm means and the immobilizer means can be set when the dimmer switch 15 is in the high beam position as shown in No. 2 in Table 1. In addition, it is possible to make the condition of the anti-theft device 1 so that only the alarm means can be set when the dimmer switch 15 is in the low beam position as shown in No. 3 in Table 1. It is also possible to make the condition of the anti-theft device 1 so that only the alarm means can be set when the dimmer switch 15 is in the high beam position as shown in No. 4 in Table 1. Furthermore it is possible to make the condition of the anti-theft device 1 so that only the immobilizer means can be set when the dimmer switch 15 is in the low beam position as shown in No. 5 in Table 1 and similarly so that only the immobilizer means can be set when the dimmer switch 15 is in the high beam position as shown in No. 6 in Table 1. It is further possible, not limited to the combination in Table 1, to make the

device 1 anti-theft caution condition so that at least one of the alarm means and the immobilizer means is set to the caution condition when the ignition switch 10 is turned "OFF" in condition of the dimmer switch 15 either in the high beam or the low beam position. In any case it is possible to easily determine whether it should be set to the anti-theft caution condition or not. In addition, easiness of selection makes it possible to prevent unintentional generation of alarm sound and disability of start of engine.

【0038】

In the arrangement described above, the selection at which setting in Table 1 the anti-theft device 1 should be operated can be determined in a secured manner by the anti-theft control circuit 5 or in a selectable manner by providing a switch in the anti-theft control circuit 5 for selecting at which setting in Table 1 the anti-theft device 1 should be operated. By providing one anti-theft device of vehicle 1 with free setting selection ability, it is possible to have easily setting of selection suitable for preference of driver, destination of vehicle, type of vehicle, or cost of vehicle and thus possible to reduce the manufacturing cost thereof.

【0039】

In addition, according to the arrangement described above, since the setting confirmation sound can be generated when it has set to the anti-theft caution condition, it is possible to easily know whether the device 1 has been set to the anti-theft caution condition. Furthermore by providing the device 1 with the hazard warning lamp flashing switch, it is possible to commence the flashing of the hazard warning lamps under a condition in which the alarm means is not set. Also it is possible to easily add the hazard warning lamp flashing function to a vehicle having been not provided with the hazard warning lamp flashing function by providing the anti-theft device 1 with such a function.

## Second embodiment

【0040】

Fig. 4 is a flow chart showing the operation of the second embodiment of the anti-theft device of vehicle of the present invention.

【0041】

Similarly to the anti-theft device of vehicle 1 shown in Fig. 1 and Fig. 2, the anti-theft device of vehicle of the second embodiment comprises anti-theft control circuit 5 and relays 6~8. Connected to the anti-theft device of vehicle 1 are an ignition switch 10, a dimmer switch 15, a headlight 16, a sensor 17, an ECU 11, a turn signal lamp (L) 25, a turn signal lamp (R) 26, an alarm means 20, and an indicator 21. Since each of these structural element is same as that of the first embodiment, detail description of them will be omitted. Although the arrangement shown in Figs. 1 and 2 includes two immobilizer means for inputting the ignition switch 10 to relay 6, it is sufficient for the anti-theft device 1 to include at least one immobilizer means. In addition although the arrangement is structured so that respective conditions of the dimmer switch 15 and the headlight 16 can be inputted, it is sufficient for the anti-theft device 1 to have at least one of them. Furthermore, the function of lighting the turn signal lamps (L, R) 25 and 26 is not necessarily required.

【0042】

Then the operation of the anti-theft device of vehicle 1 will be hereinafter described. Reference numerals enclosed in brackets in the following description correspond to those shown in a flow chart of Fig. 4.

【0043】

In the description below, circumstances in which the anti-theft device 1 is set when the headlight 16 is in the lighting condition will be described (No. 1 in Table 2 below). Table 2 shows several combinations of setting obtained from condition of the headlight 16. Details of Table 2 will be described later.

【0044】

{Table 2}

		Headlight	
		Lighting condition	Lighting-off condition
No.1	Alarm+Immobilizer	Set	—
No.2	Alarm+Immobilizer	—	Set
No.3	Alarm	Set	—
No.4	Alarm	—	Set
No.5	Immobilizer	Set	—
No.6	Immobilizer	—	Set

【0045】

First of all, the condition of the ignition switch 10 is observed (S201) and concrete control is carried out when the ignition switch 10 is turned “OFF” (S201-OFF). When the ignition switch 10 is turned “OFF”, confirmation of the condition of the lighting of the headlight 16 is carried out (S202). When the headlight 16 is in the lighting-off condition, it is not shifted to the anti-theft caution condition and thus the operation of the ignition switch 10 causes only stop of engine (S202-Lighting-off).

【0046】

When the headlight 16 is in the lighting condition (S202-Lighting), the anti-theft is set (S203). One concrete content of the setting of anti-theft is, first of all, to generate setting confirmation sound for indicating the setting of anti-theft. The setting confirmation sound is generated by using the alarm means 20. In addition, the immobilizer means is operated so that the relay 6 is turned “OFF” not so as to start an engine. Then it is indicated by flashing the indicator 21 that the situation is now in the anti-theft caution condition (S204). Thus the driver can leave his (or her) vehicle.

【0047】

When the key is inserted to the ignition switch 10 and turned “ON” during the anti-theft caution condition (S205-ON), the anti-theft is released (S208). One concrete content of the releasing of anti-theft is to light-off the

indicator 21 and to stop the immobilizer means by turning the relay 6 "ON".

【0048】

Under the anti-theft caution condition, operation of the sensor 17 is observed by the anti-theft control circuit 5 (S206). If the sensor 17 detects unintentional vibration or movement of vehicle under the anti-theft caution condition (S206-Yes), alarm is generated (S207). One concrete content of the alarm is to generate alarm sound by the alarm means 20. It is additionally possible to flash the turn signal lamps (L, R) 25 and 26.

【0049】

As described above, since it is shifted to the anti-theft caution condition when the ignition switch 10 of vehicle is turned "OFF" under the headlight 16 is in the lighting condition, it can be easily determined whether or not it should be set in the anti-theft caution condition only by selecting the condition (lighting or lighting-off condition) of the headlight 16. The easiness of selection makes the selecting method unforgettable and thus makes it possible to prevent generation of unintentional alarm sound and disability of start of engine. That is, when a driver does not want to set the anti-theft device 1, for example, when a driver leaves a vehicle within a range the eye can reach e.g. such as a case of fuel charge at a gas station, it can provide easy selection and prevent unintentional generation of alarm sound and disability of start of engine only by setting the headlight 16 at the light-off condition.

【0050】

Although it has described above that the alarm means and the immobilizer means are set when the headlight 16 is in the lighting condition as shown in No.1 in Table 2, it is also possible to make the condition of the anti-theft device 1 so that the alarm means and the immobilizer means can be set when the headlight 16 is in the lighting-off condition as shown in No. 2 in Table 2. In addition, it is possible to make the condition of the anti-theft

device 1 so that only the alarm means can be set when the headline 16 is in the lighting condition as shown in No. 3 in Table 2. It is also possible to make the condition of the anti-theft device 1 so that only the alarm means can be set when the headlight 16 is in the lighting-off condition as shown in No. 4 in Table 2. Furthermore it is possible to make the condition of the anti-theft device 1 so that only the immobilizer means can be set when the headlight 16 is in the lighting condition as shown in No. 5 in Table 2 and similarly so that only the immobilizer means can be set when the headlight 16 is in the lighting-off condition as shown in No. 6 in Table 2. It is further possible, not limited to the combination in Table 2, to make the device 1 anti-theft caution condition so that at least one of the alarm means and the immobilizer means is set to the caution condition when the ignition switch 10 is turned "OFF" in condition of the headlight 16 either in the lighting or the lighting-off condition. In any case it is possible to easily determine whether it should be set to the anti-theft caution condition or not. In addition, easiness of selection makes it possible to prevent unintentional generation of alarm sound and disability of start of engine.

[0051]

In the arrangement described above, the selection at which setting in Table 2 the anti-theft device 1 should be operated can be determined in a secured manner by the anti-theft control circuit 5 or in a selectable manner by providing a switch in the anti-theft control circuit 5 for selecting at which setting in Table 2 the anti-theft device 1 should be operated. By providing one anti-theft device of vehicle 1 with free setting selection ability, it is possible to have easily setting of selection suitable for preference of driver, destination of vehicle, type of vehicle, or cost of vehicle and thus possible to reduce the manufacturing cost thereof.

[0052]

In addition, according to the arrangement described above, since the



setting confirmation sound can be generated when it has set to the anti-theft caution condition, it is possible to easily know whether the device 1 has been set to the anti-theft caution condition. Furthermore by providing the device 1 with the hazard warning lamp flashing switch, it is possible to commence the flashing of the hazard warning lamps under a condition in which the alarm means is not set. Also it is possible to easily add the hazard warning lamp flashing function to a vehicle having been not provided with the hazard warning lamp flashing function by providing the anti-theft device 1 with such a function.

### Third embodiment

【0053】

Fig. 5 is a flow chart showing the operation of the third embodiment of the anti-theft device of vehicle of the present invention.

【0054】

Similarly to the anti-theft device of vehicle 1 shown in Fig. 1 and Fig. 2, the anti-theft device of vehicle of the third embodiment comprises anti-theft control circuit 5 and relays 6~8. Connected to the anti-theft device of vehicle 1 are an ignition switch 10, a dimmer switch 15, a headlight 16, a sensor 17, an ECU 11, a turn signal lamp (L) 25, a turn signal lamp (R) 26, an alarm means 20, and an indicator 21. Since each of these structural element is same as that of the first embodiment, detail description of them will be omitted. Although the arrangement shown in Figs. 1 and 2 includes two immobilizer means for inputting the ignition switch 10 to relay 6, it is sufficient for the anti-theft device 1 to include at least one immobilizer means. In addition although the arrangement is structured so that respective conditions of the dimmer switch 15 and the headlight 16 can be inputted, it is sufficient for the anti-theft device 1 to have at least one of them. Furthermore, the function of lighting the turn signal lamps (L, R) 25 and 26 is not necessarily required.

【0055】

Then the operation of the anti-theft device of vehicle 1 will be hereinafter described. Reference numerals enclosed in brackets in the following description correspond to those shown in a flow chart of Fig. 5.

【0056】

In the description below, circumstances in which the anti-theft device 1 is set when the dimmer switch 15 is in the low beam position and the headlight 16 is in the lighting condition will be described (Table 3).

【0057】

(Table 3)

	Dimmer switch	Headlight	Alarm	Immobilizer
No. 1	Low beam position	Lighting	Set	Set
No. 2		Lighting-off	Set	—
No. 3	High beam position	Lighting	—	Set
No. 4		Lighting-off	—	—

【0058】

First of all, the condition of the ignition switch 10 is observed (S301) and concrete control is carried out when the ignition switch 10 is turned “OFF” (S301-OFF). When the ignition switch 10 is turned “OFF”, confirmation of the position of the dimmer switch 15 is carried out (S302). When the dimmer switch 15 is in the high beam position, confirmation of the condition of the headlight 16 is carried out (S310). When the headlight 16 is in the lighting-off condition (No.4 in Table 3), it is not shifted to the anti-theft caution condition and thus the operation of the ignition switch 10 causes only stop of engine (S310-Lighting-off).

【0059】

When the dimmer switch 15 is in the low beam position (S302-Low), the anti-theft is set (S303). One concrete content of the setting of anti-theft is, first of all, to generate setting confirmation sound for indicating the setting of anti-theft. The setting confirmation sound is generated by using the alarm means 20. In addition, when the headlight 16 is in the lighting condition, the

relay 6 is turned "OFF" to operate the immobilizer means so as not to start an engine. When the headlight 16 is in the light-off condition, only the alarm means is set. In addition, when the dimmer switch 15 is in the high beam position and the headlight 16 is in the lighting condition (S310-lighting), only the immobilizer means is set. Then it is indicated by flashing the indicator 21 that the situation is now in the anti-theft caution condition (S304). Thus the driver can leave his (or her) vehicle.

【0060】

When the key is inserted to the ignition switch 10 and turned "ON" during the anti-theft caution condition (S305-ON), the anti-theft is released (S308). One concrete content of the releasing of anti-theft is to light-off the indicator 21 and to stop the immobilizer means by turning the relay 6 "ON" (the immobilizer function is unconcerned in cases of Nos. 2 and 4 in Table 3).

【0061】

Under the anti-theft caution condition, operation of the sensor 17 is observed by the anti-theft control circuit 5 (S306). If the sensor 17 detects unintentional vibration or movement of vehicle under the anti-theft caution condition (S306-Yes), if the alarm means is set, alarm is generated (S307). One concrete content of the alarm is to generate alarm sound by the alarm means 20. It is additionally possible to flash the turn signal lamps (L, R) 25 and 26.

【0062】

As described above, since it is shifted to the anti-theft caution condition when the ignition switch 10 of vehicle is turned "OFF" under the selection of conditions of the dimmer switch 15 and the headlight 16, it can be easily determined whether or not it should be set in the anti-theft caution condition only by selecting combination of the position (high beam position or low beam position) of the dimmer switch 15 and the condition (lighting or lighting-off condition) of the headlight 16. The easiness of selection makes the selecting

method unforgettable and thus makes it possible to prevent generation of unintentional alarm sound and disability of start of engine. That is, when a driver does not want to set the anti-theft device 1, for example, when a driver leaves a vehicle within a range the eye can reach e.g. such as a case of fuel charge at a gas station, it can provide easy selection and prevent unintentional generation of alarm sound and disability of start of engine only by selecting the combination of the position (high beam position or low beam position) of the dimmer switch 15 and the condition (lighting or lighting-off condition) of the headlight 16.

[0063]

Although it has described above that the alarm means and the immobilizer means are set in accordance with the combination of the conditions shown in Table 3, it is also possible to set the alarm means and the immobilizer means in accordance with other combination of the dimmer switch 15 and the headlight 16. It is further possible, not limited to the combination in Table 3, to make the device 1 anti-theft caution condition so that at least one of the alarm means and the immobilizer means is set to the caution condition when the ignition switch 10 is turned "OFF" in condition of the headlight 16 by selecting the combination of the position (high beam position or low beam position) of the dimmer switch 15 and the condition (lighting or lighting-off condition) of the headlight 16. In any case it is possible to easily determine whether it should be set to the anti-theft caution condition or not. In addition, easiness of selection makes it possible to prevent unintentional generation of alarm sound and disability of start of engine.

[0064]

In the arrangement described above, the selection at which setting in Table 3 the anti-theft device 1 should be operated can be determined in a secured manner by the anti-theft control circuit 5 or in a selectable manner by providing a switch in the anti-theft control circuit 5 for selecting at which

setting the anti-theft device 1 should be operated. By providing one anti-theft device of vehicle 1 with free setting selection ability, it is possible to have easily setting of selection suitable for preference of driver, destination of vehicle, type of vehicle, or cost of vehicle and thus possible to reduce the manufacturing cost thereof.

【0065】

In addition, according to the arrangement described above, since the setting confirmation sound can be generated when it has set to the anti-theft caution condition, it is possible to easily know whether the device 1 has been set to the anti-theft caution condition. Furthermore by providing the device 1 with the hazard warning lamp flashing switch, it is possible to commence the flashing of the hazard warning lamps under a condition in which the alarm means is not set. Also it is possible to easily add the hazard warning lamp flashing function to a vehicle having been not provided with the hazard warning lamp flashing function by providing the anti-theft device 1 with such a function.

#### Fourth embodiment

【0066】

Fig. 6 is a flow chart showing the operation of the fourth embodiment of the anti-theft device of vehicle of the present invention.

【0067】

Similarly to the anti-theft device of vehicle 1 shown in Fig. 1 and Fig. 2, the anti-theft device of vehicle of the fourth embodiment comprises anti-theft control circuit 5 and relays 6~8. Connected to the anti-theft device of vehicle 1 are an ignition switch 10, a dimmer switch 15, a headlight 16, a sensor 17, an ECU 11, a turn signal lamp (L) 25, a turn signal lamp (R) 26, an alarm means 20, and an indicator 21. Since each of these structural element is same as that of the first embodiment, detail description of them will be omitted. Although the arrangement shown in Figs. 1 and 2 includes two immobilizer

means for inputting the ignition switch 10 to relay 6, it is sufficient for the anti-theft device 1 to include at least one immobilizer means. In addition although the arrangement is structured so that respective conditions of the dimmer switch 15 and the headlight 16 can be inputted, it is sufficient for the anti-theft device 1 to have at least one of them. Furthermore, the function of lighting the turn signal lamps (L, R) 25 and 26 is not necessarily required.

[0068]

Then the operation of the anti-theft device of vehicle 1 will be hereinafter described. Reference numerals enclosed in brackets in the following description correspond to those shown in a flow chart of Fig. 6.

[0069]

First of all, the condition of the ignition switch 10 is observed (S401) and concrete control is carried out when the ignition switch 10 is turned "OFF" (S401-OFF). When the ignition switch 10 is turned "OFF", confirmation of the position of the dimmer switch 15 is carried out (S402). When the dimmer switch 15 is in the high beam position, it is not shifted to the anti-theft caution condition and thus the operation of the ignition switch 10 causes only stop of engine (S402-Hi).

[0070]

When the dimmer switch 15 is in the low beam position (S402-Low), the anti-theft is set (S403). One concrete content of the setting of anti-theft is, first of all, to generate setting confirmation sound for indicating the setting of anti-theft. The setting confirmation sound is generated by using the alarm means 20. Then it is indicated by flashing the indicator 21 that the situation is now in the anti-theft caution condition (S404). Thus the driver can leave his (or her) vehicle.

[0071]

When the key is inserted to the ignition switch 10 and turned "ON" during the anti-theft caution condition (S405-ON), the relay 6 is turned

“OFF” to actuate the immobilizer means so as not to enable start of an engine (S410). Then, when the dimmer switch 15 is turned from its low beam position to its high beam position (S411-Hi), the relay 6 is turned “ON” to release the immobilizer means so as to enable start of an engine (S412) and to release the anti-theft (S408).

[0072]

Under the anti-theft caution condition, operation of the sensor 17 is observed by the anti-theft control circuit 5 (S406). If the sensor 17 detects unintentional vibration or movement of vehicle under the anti-theft caution condition (S406-Yes), alarm is generated (S407). One concrete content of the alarm is to generate alarm sound by the alarm means 20. It is additionally possible to flash the turn signal lamps (L, R) 25 and 26.

[0073]

As described above, when releasing the anti-theft caution condition, it is possible to observe the change of the condition of the dimmer switch 15 and the headlight 16. By enabling the anti-theft caution condition to be released only when the several conditions are satisfied it is possible to firmly achieve the anti-theft of vehicle.

[0074]

Finally a concrete form of the alarm means 20 which is a commonly used in the embodiments 1~4. Fig. 7 shows the detail of the embodiment of the alarm means 20. The alarm means comprises the anti-theft control circuit 5, a piezoelectric buzzer 20a forming the alarm means 20, and a piezoelectric buzzer driving circuit 9 for driving the piezoelectric buzzer 20a. As previously described, the anti-theft control circuit 5 is a controlling section for wholly control the anti-theft device of vehicle 1. The anti-theft control circuit 5 includes an oscillating means for generating oscillating signals controlled by hardware or software. According to one example of the oscillating means controlled by software, “ON” and “OFF” of I/O port of CPU are repeated by

software and the oscillating signals are generated by its repeating cycle. The piezoelectric buzzer driving circuit 9 generate oscillating signals having sufficient electric power to drive the piezoelectric buzzer by superposing electric current on the oscillating signals from the anti-theft control circuit. The anti-theft control circuit 5, the piezoelectric buzzer driving circuit 9 and the piezoelectric buzzer 20a are formed on the same circuit board.

【0075】

In the anti-theft device of vehicle of the prior art, the oscillating circuit for generating the oscillating signals, the piezoelectric buzzer driving circuit and the piezoelectric buzzer are integrally formed and these structural elements are formed separately from the anti-theft control circuit. In addition The anti-theft control circuit only controls “ON” and “OFF” of the piezoelectric buzzer. Accordingly it is impossible to change the receiving frequency of the piezoelectric buzzer and sound pressure level from the anti-theft control circuit.

【0076】

However according to the anti-theft device of vehicle of the present invention, since the anti-theft control circuit 5, the piezoelectric buzzer driving circuit 9 and the piezoelectric buzzer 20a are integrally formed and the anti-theft control circuit 5 has the oscillating means, it is possible to change the oscillating frequency from the anti-theft control circuit 5 and thus it is possible to appropriately change sound tone of the piezoelectric buzzer. In addition it is possible to adjust the sound pressure level of the piezoelectric buzzer 20a by using the frequency characteristics between the frequency and the sound pressure of the piezoelectric buzzer 20a. Furthermore as shown in Fig. 7, when the piezoelectric buzzer 20a is used with its two inputs being inputted by oscillating signals having respectively opposite phases, it is possible to adjust the sound pressure by not inputting any oscillating signal to one input or by inputting oscillating signal of any phase difference not



opposite signal.

Applicability to industries

The anti-theft device of vehicle of the present invention can be applied to various kinds of vehicles having a dimmer switch and headlight such as a 4-wheeled vehicle, a motorcycle, a buggy, a snowmobile, and snow vehicle etc.

The present invention has been described with reference to the preferred embodiment. Obviously, modifications and alternations will occur to those of ordinary skill in the art upon reading and understanding the preceding detailed description. It is intended that the present invention be construed as including all such alternations and modifications insofar as they come within the scope of the appended claims or the equivalents thereof.